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CLIMATIC MODELS THAT WILL PROVIDE TIMELY MISSION SUCCESS INDICATORS FOR PLANNING AND SUPPORTING WEATHER SENSITIVE OPERATIONS

by

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SCIENTIFIC REPORT NUMBER 1

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Analytic formulae are presented for modelling climatic mission success indicators for joint ceiling and visibility categories from a knowledge of the separate unconditional probabilities for these two parameters for the same location with zero time lag.

Analytic formulations are similarly presented which extend the modelling capabilities to incorporate considerations of time

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differentials and distance separations. A method is presented for compacting the *RUSSWO statistics for ceilings and visibilities (by a factor of approximately 1 to 100) for ready manual or computer reference.

*Revised Uniform Summaries of Surface Weather Observations Prepared for many stations by Environmental Technical Applications Center (USAF).

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PERSONNEL

The following members of the Department of Earth and Atmospheric Sciences were engaged in various stages of the research. Professor Martin was the principal investigator.

Mrs. Eloise Myers was the principal graduate assistant throughout the entire period. She served the role of co-investigator and chief computer scientist in all phases of the research.

Alan Kreiner, Robert Thiele and Ron Przyblinski were graduate students who participated in the data gathering and processing phases.

Robert Rau and James Haney were undergraduates who likewise served to process the data.

Mrs. Frances Brummell served as secretary throughout the entire course of the research.

I. INTRODUCTION

AFGL-TR-76-0249 dated 31 August 1976 contains procedures for modelling Climatic Mission Success Indicators (CMSI's) for jointly considered occurrences of ceiling and visibilities as a function of month, separation distance, and ceiling and visibility categories. These relationships were extracted from processed data provided by ETAC for some thirty station pairs dispersed throughout the Northern Hemisphere. Billiken factor (B-factor) arrays were constructed to model joint probability relationships between ceiling/visibility occurrences for separation distances within 300 miles (see Fig. 1). The procedure is merely to select the appropriate B-factor from figure 1 (or deduce it using the analytic formulation provided in that report) and apply the relationship

$$CMSI = 1 - P_a - (B\text{-factor}) \times P_b \qquad (1)$$

where $P_a > P_b$. Here P_a and P_b are the probabilities that the respective stations will have ceilings less that 500' and/or visibilities less than one mile in the top display or ceilings less than 200' and/or visibilities less than 1/2 mile in the bottom one.

II. MODELLING THE JOINT PROBABILITY FUNCTION $P_a \wedge P_b$

This report expands the modelling efforts to include time differentials between stations and a wider range of flexibility in selecting ceiling and visibility categories. In particular, treatment of ceilings and visibilities as separate entities is emphasized. Preliminary to this extension was another modelling effort to provide comparisions between CMSI's when ceiling and visibility data are treated separately and when they are jointly considered. In each case neither a space nor time lag factor is involved. The problem is the following: Suppose one had RUSSWO data such as the randomly selected example provided in figure 2. How can the respective ceiling and visibility probabilities of occurrences along the margins of the RUSSWO be used to model the joint probabilities internal to the display? Such knowledge would constitute a valuable aid to the forecaster as well as the climatologist by providing a gauge for checking individual estimates of ceiling and visibility probabilities (regardless of whether they were obtained via climatological or forecast procedures) against the appropriate CMSI. Such a model is shown in figure 3.

Route Distance in Air Miles

Month	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Jan.	0	10	15	22	28	32	35	40	45	47	50	55	56	57	58	59	60	61	64	68	69	70	72	75	77	80	82	83	84	85	86
Feb.	0	10	17	23	30	35	40	45	46	48	51	55	58	60	61	63	65	70	70	73	75	77	78	80	81	82	92	83	84	85	86
March	0	12	20	26	32	35	40	45	50	55	58	61	65	68	70	72	74	77	80	80	85	85	86	87	88	89	90	90	90	90	90
April	0	15	22	30	32	40	45	50	55	60	61	66	70	75	80	81	84	85	87	90	91	92	94	94	95	95	96	96	96	96	97
May	0	17	28	35	40	45	50	57	60	70	75	80	84	86	87	89	91	92	93	95	95	95	95	95	95	96	96	96	96	97	97
June	0	20	30	38	44	50	55	60	65	72	77	82	85	87	90	92	94	95	95	95	95	95	95	95	95	96	96	96	95	97	97
July	0	17	30	40	47	52	60	65	70	74	77	82	84	87	90	92	95	95	95	95	95	95	95	95	95	96	96	96	96	97	97
August	0	16	28	38	45	52	55	63	68	72	75	79	81	84	85	90	90	91	92	92	94	95	95	95	95	96	96	96	96	97	97
Sept.	0	15	20	30	40	44	52	60	62	68	71	74	77	80	82	84	85	88	90	90	91	93	94	94	95	96	96	96	96	97	97
Oct.	0	14	18	25	31	39	47	50	53	59	60	63	65	68	70	72	75	80	83	85	88	90	90	91	92	93	95	96	96	96	97
Nov.	0	12	15	20	27	31	40	45	48	50	52	55	57	60	65	66	68	70	73	75	80	80	82	85	87	88	89	90	90	90	90
Dec.	0	10	14	19	25	30	36	40	43	46	47	50	51	53	55	58	59	62	63	65	69	71	75	80	82	83	83	84	85	85	86

B-Factors for expressing meteorological homogeneity ceilings less than 500' and/or visibilities less than one mile as a function of distance and month.

Route Distance in Air Miles

Month	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Jan.	0	10	20	23	32	37	48	49	52	54	57	59	62	64	68	69	70	72	74	75	77	80	81	83	85	87	88	90	91	91	91
Feb.	0	10	20	23	34	40	48	51	53	55	60	61	63	68	70	72	73	75	79	80	83	84	85	87	90	92	93	94	94	94	94
March	0	12	22	30	39	46	51	55	60	64	68	70	71	78	80	82	83	84	85	86	88	90	91	93	94	95	95	95	95	95	95
April	0	12	23	32	42	50	57	63	65	70	74	78	80	85	86	88	89	90	92	94	95	95	95	95	95	95	95	95	95	95	95
May	0	11	24	34	43	52	59	65	70	72	79	82	85	87	90	91	92	93	94	95	95	95	95	95	95	95	95	95	95	95	95
June	0	12	23	35	44	52	60	68	73	78	82	84	88	92	93	94	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
July	0	12	22	31	42	50	60	65	72	80	84	85	90	92	94	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
August	0	12	21	31	41	49	55	60	68	78	82	85	87	90	92	93	94	94	94	94	94	94	94	94	95	95	95	95	95	95	95
Sept.	0	11	20	31	41	48	52	58	62	70	72	80	83	85	87	88	90	91	92	93	93	93	94	94	94	94	95	95	95	95	95
Oct.	0	11	20	30	40	47	51	55	60	65	70	74	77	80	83	84	85	86	90	91	92	92	93	93	93	93	94	94	94	94	94
Nov.	0	10	18	29	38	44	50	52	55	62	65	67	70	72	75	78	80	82	84	86	90	91	92	93	94	94	95	95	95	95	95
Dec.	0	10	18	25	35	40	48	50	54	58	63	65	67	70	72	74	76	78	80	83	85	87	89	91	92	93	94	94	94	94	94

Fig.1. B-Factors for expressing meteorological homogeneity ceilings less than 200' and/or visibilities less than 1/2 mile as a function of distance and month.

DATA PROCESSING DIVISION
USAF ETAC
AIR WEATHER SERVICE/MAC

14706 — Station
MCGUIRE AFB N J/WRIGHTSTOWN — Station Name
43-46,49-70 — Years
FEB — Month

PERCENTAGE FREQUENCY OF OCCURRENCE
(FROM HOURLY OBSERVATIONS)

0300-0500
Hours (L.S.T.)

VISIBILITY STATUTE MILES

	≥ 10	≥ 6	≥ 5	≥ 4	≥ 3	≥ 2-1/2	≥ 2	≥ 1-1/2	≥ 1-1/4	≥ 1	≥ 3/4	≥ 5/8	≥ 1/2	≥ 5/16	≥ 1/4	≥ 0	
No Ceiling	27.1	43.7	46.5	47.8	48.6	49.8	49.4	49.9	50.0	50.2	50.3	50.4	50.5	50.5	50.5	51.0	No Ceiling
≥ 20000	28.8	46.9	50.0	51.2	52.0	52.2	52.8	53.3	53.5	53.6	53.8	53.8	54.0	54.0	54.0	54.5	≥ 20000
≥ 18000	28.8	46.9	50.0	51.3	52.1	52.3	52.9	53.4	53.5	53.7	53.8	53.9	54.0	54.0	54.1	54.5	≥ 18000
≥ 16000	28.9	47.1	50.3	51.5	52.4	52.5	53.1	53.6	53.8	54.0	54.1	54.1	54.3	54.3	54.4	54.8	≥ 16000
≥ 14000	29.1	47.8	51.0	52.2	53.0	53.2	53.9	54.4	54.5	54.7	54.8	54.9	55.0	55.0	55.1	55.5	≥ 14000
≥ 12000	29.4	48.9	52.1	53.4	54.3	54.5	55.2	55.8	55.9	56.1	56.2	56.3	56.4	56.4	56.5	56.9	≥ 12000
≥ 10000	30.4	50.4	53.8	55.1	56.2	56.4	57.2	57.7	57.9	58.0	58.2	58.2	58.4	58.4	58.4	58.9	≥ 10000
≥ 9000	30.9	51.4	55.0	56.4	57.4	57.7	58.4	59.0	59.1	59.3	59.4	59.5	59.7	59.7	59.7	60.2	≥ 9000
≥ 8000	32.0	53.2	57.0	58.4	59.7	60.0	60.8	61.3	61.4	61.6	61.8	61.8	62.0	62.0	62.0	62.3	≥ 8000
≥ 7000	32.6	54.6	58.4	60.1	61.4	61.7	62.4	63.0	63.1	63.4	63.5	63.6	63.8	63.8	63.8	64.3	≥ 7000
≥ 6000	33.4	56.5	60.3	62.1	63.6	63.9	64.7	65.2	65.4	65.7	65.8	65.8	66.0	66.0	66.1	66.5	≥ 6000
≥ 5000	34.7	59.6	63.7	65.6	67.2	67.5	68.3	68.9	69.1	69.3	69.5	69.5	69.8	69.8	69.8	70.3	≥ 5000
≥ 4500	35.4	61.4	65.7	67.7	69.3	69.7	70.5	71.2	71.3	71.7	71.8	71.8	72.1	72.1	72.2	72.6	≥ 4500
≥ 4000	36.4	63.1	67.5	69.5	71.3	71.6	72.4	73.1	73.3	73.6	73.8	73.8	74.0	74.0	74.1	74.6	≥ 4000
≥ 3500	37.6	65.2	69.8	72.1	73.8	74.1	75.1	75.7	75.9	76.2	76.4	76.4	76.7	76.7	76.7	77.2	≥ 3500
≥ 3000	38.1	66.8	71.6	73.9	75.7	76.1	77.2	77.9	78.1	78.4	78.6	78.8	78.8	78.8	78.9	79.4	≥ 3000
≥ 2500	38.5	67.8	72.8	75.3	77.2	77.7	78.6	79.5	79.7	80.1	80.2	80.3	80.5	80.5	80.6	81.2	≥ 2500
≥ 2000	38.9	69.1	74.2	76.8	78.9	79.4	80.7	81.4	81.7	82.1	82.3	82.3	82.6	82.6	82.7	83.2	≥ 2000
≥ 1800	38.9	69.3	74.4	77.0	79.2	79.7	81.0	81.7	82.0	82.4	82.7	82.7	82.9	82.9	83.0	83.6	≥ 1800
≥ 1500	38.9	70.0	75.2	77.9	80.3	80.8	82.2	83.0	83.4	83.8	84.0	84.1	84.3	84.3	84.4	84.9	≥ 1500
≥ 1200	38.9	70.3	75.6	78.5	81.0	81.5	83.1	84.0	84.3	84.8	85.0	85.1	85.3	85.3	85.4	85.9	≥ 1200
≥ 1000	38.9	70.8	76.2	78.9	81.5	82.1	83.7	84.6	85.0	85.6	85.9	85.9	86.1	86.1	86.2	86.8	≥ 1000
≥ 900	39.0	71.0	76.5	79.2	81.9	82.6	84.2	85.1	85.6	86.1	86.5	86.5	86.7	86.7	86.8	87.4	≥ 9900
≥ 800	39.0	71.0	76.5	79.4	82.3	83.0	84.7	85.8	86.3	86.8	87.2	87.3	87.5	87.5	87.7	88.2	≥ 800
≥ 700	39.0	71.1	76.6	79.5	82.5	83.2	85.1	86.1	86.6	87.2	87.7	87.8	88.0	88.0	88.2	88.8	≥ 700
≥ 600	39.0	71.1	76.7	79.8	83.0	83.8	85.9	87.1	87.6	88.3	88.7	88.8	89.1	89.1	89.3	89.9	≥ 600
≥ 500	39.0	71.3	77.0	80.2	83.7	84.5	87.2	88.5	89.2	90.1	90.6	90.6	91.1	91.1	91.3	91.9	≥ 500
≥ 400	39.0	71.3	77.1	80.4	83.8	84.9	88.2	89.7	90.5	91.4	92.1	92.1	92.7	92.7	93.0	93.6	≥ 400
≥ 300	39.0	71.3	77.1	80.5	83.9	85.0	88.5	90.3	91.1	92.3	93.0	93.1	93.8	93.8	94.1	94.8	≥ 300
≥ 200	39.0	71.3	77.1	80.5	84.1	85.1	88.7	90.8	91.7	93.2	94.1	94.3	95.2	95.3	95.7	96.4	≥ 200
≥ 100	39.0	71.3	77.1	80.5	84.1	85.1	88.7	90.9	91.9	93.4	94.5	94.6	95.7	96.2	96.9	98.0	≥ 100
≥ 0	39.0	71.3	77.1	80.5	84.1	85.1	88.7	90.9	91.9	93.4	94.5	94.6	95.7	96.2	97.0	100.0	≥ 0
	≥ 10	≥ 6	≥ 5	≥ 4	≥ 3	≥ 2-1/2	≥ 2	≥ 1-1/2	≥ 1-1/4	≥ 1	≥ 3/4	≥ 5/8	≥ 1/2	≥ 5/16	≥ 1/4	≥ 0	

Fig. 2

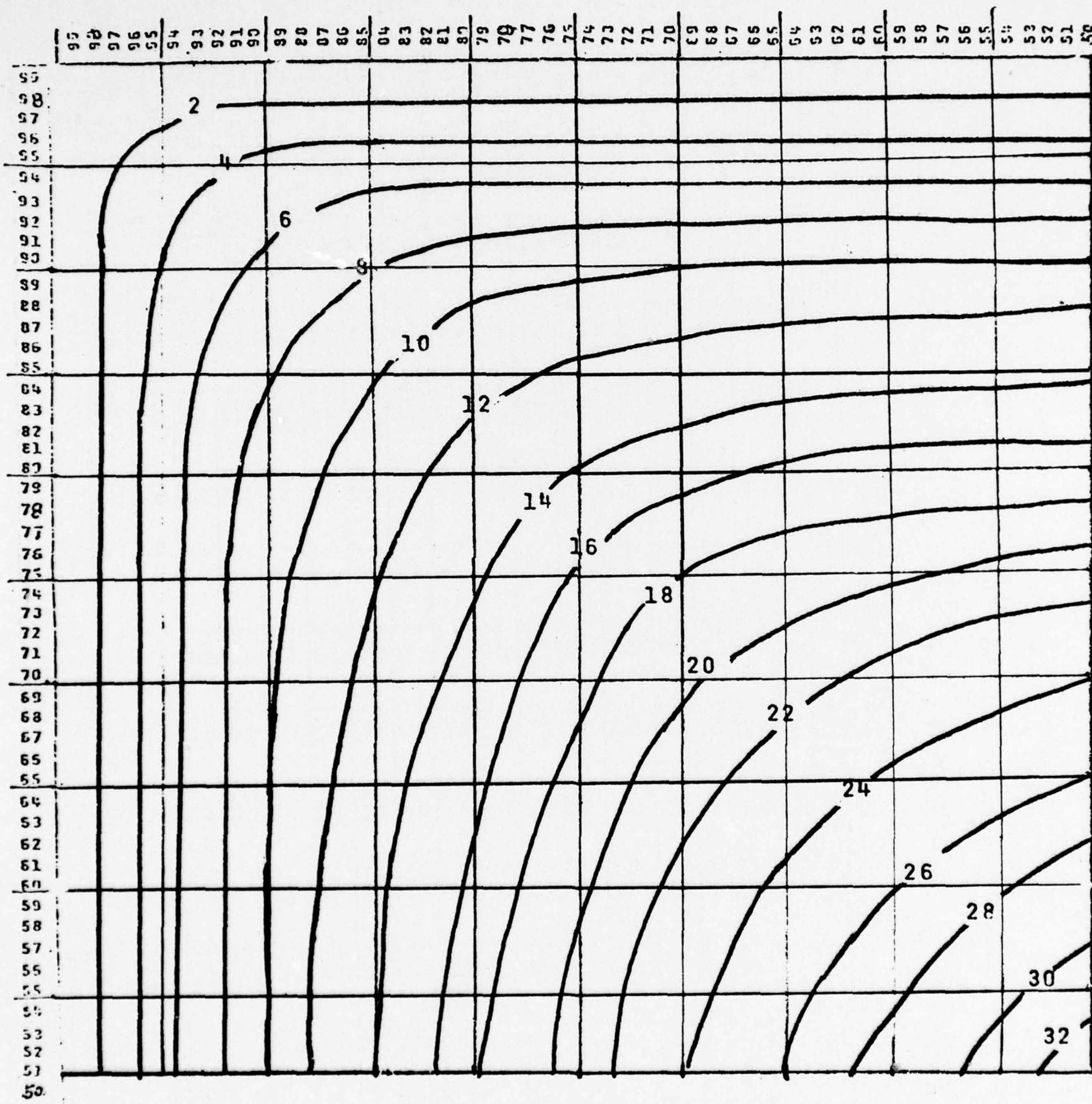

Fig. 3. Joint probabilities of ceilings and visibilities as a function of their respective unconditional probabilities

Due to the symmetry of $P_a \wedge P_b$ isolines in this display, it is arbitrary whether unconditionals of ceiling or visibility are assigned to the respective axes. Such unconditional probabilities are found along the margins of figure 2. Figure 3 was produced using data randomly selected with respect to hour, month and ceiling/visibility category from a vast array of RUSSWO data scattered throughout the Northern Hemisphere. In general the isolines fit the "observed" values within $\pm$ 2%. Occasionally the situation arises where the errors are significantly larger than $\pm$ 2% for the higher categories due to less dependency between ceilings and visibilities for some particular location or season than that implicit to equation 3. This problem is under investigation to set up criteria for identifying and treating these instances by applying modified versions of equation 3.

Example 1

An illustration of the use of figure 3 follows from the data in figure 2 where the probability of ceilings $\geq$ 2000' and/or visibilities $\geq$ 0 is .832. The probability of visibilities $\geq$ 1 mile and/or ceilings $\geq$ 0 is .934. These values inserted into figure 3 show $P_a \wedge P_b$ to be approximately 0.06. Computations by direct formulation using equation 2 provide a ready verification of the modelled $P_a \wedge P_b$ since the CMSI is known to be .821.

$$\text{CMSI} = 1 - P_a - P_b + P_a \wedge P_b \qquad (2)$$

or

$$.821 = 1.00 - .168 - .066 + P_a \wedge P_b, \text{ or } P_a \wedge P_b = .055.$$

Example 2

As another example ceilings $\geq$ 3000' and/or visibility $\geq$ 0 show a probability of .794. Visibilities $\geq$ 5/16 mile and/or ceilings $\geq$ 0' exhibit a probability of .962. The "observed" CMSI is .788. These values inserted into equation 2 show $P_a \wedge P_b$ to be .032 which is a very close approximation to the value provided by the graph in Fig. 3. Note that figure 3 pertains to any desired ceiling/visibility category irrespective of station location, month or hour of day.

The isolines of figure 3 are sufficiently hyperbolic to permit their representation by analytic formula, i.e.,

$$P_a \wedge P_b = \frac{P_a + P_b}{2} - \sqrt{\left(\frac{P_a + P_b}{2}\right)^2 - .87\, P_a P_b} \qquad (3)$$

This formula will be applied to the data of examples one and two above for illustration purposes. In example 1, P_a was found to be .168 and P_b = .066. Inserting these values into equation 3 gives

$$P_{a \wedge} P_b = .117 - \sqrt{(.117)^2 - .87\ (.168)\ (.066)}$$

$$= .117 - \sqrt{.0137 - .0096}$$

$$= .117 - .064 = .053$$

as compared with an "observed" value of .055.

From example 2

$$P_{a \wedge} P_b = \frac{.206 + .038}{2} - \sqrt{\left(\frac{.206 + .038}{2}\right)^2 - .206\ (.038)(.87)}$$

$$P_{a \wedge} P_b = \sqrt{.122 - .01488 - .00681}$$

$$= .122 - .09 = .032$$

to be compared with an "observed" $P_{a \wedge} P_b$ of .032.

III. MODELLING THE CMSI'S WHEN NEITHER A TIME LAG FACTOR NOR A SEPARATION DISTANCE IS INVOLVED

It follows directly from equation 2 and 3 that

$$CMSI = 1 - \frac{P_a + P_b}{2} - \sqrt{\left(\frac{P_a + P_b}{2}\right)^2 - .87\ P_a P_b} \qquad (4)$$

Example 3

As an independent example from the previous two, let us apply this formula to ceilings ≥ 500' with visibility ≥ 0 and visibility ≥ 1/2 mile with ceilings ≥ 0. The respective unconditional probabilities from figure 2 are .919 and .957. Thus, P_a = .081 and P_b = .043. From equation 4,

$$CMSI = 1 - .062 - \sqrt{(.062)^2 - .87\ (.043)(.081}$$

$$= 1 - .062 - \sqrt{.0038 - .0030}$$

$$= 1 - .062 - .028 = .91$$

which matches the value given in the RUSSWO.

IV. MODELLING THE CMSI'S WHEN TIME LAG AND SEPARATION DISTANCES ARE CONSIDERED

Any one of a number of analytic formulations could have been used in modelling $P_a \wedge P_b$ as a function of time and space. For example, the Billiken or L-factors of the previous study (AFGL-TR-76-0249) or correlation procedures advanced by other investigators would have presumably worked sufficiently well. We chose to use the equation,

$$r^2 = \frac{P_a \wedge P_b - (P_a)(P_b)}{P_b - (P_a)(P_b)} \quad \text{where } P_a > P_b \tag{5}$$

since values of r computed by this formula closely approximate the correlation coefficients needed to model $P_a \wedge P_b$ using the bivariate normal tables provided by the U. S. Bureau of Standards. Its magnitudes range from 0 to 1 and do not include chance occurrences thereby constituting a slight improvement over the Billiken factor approach. Note that the numerator on the right hand side of equation 5 represents the joint relationship in excess of chance. The denominator represents the maximum value that $P_a \wedge P_b$ could possibly attain in excess of chance.

Irrespective of its relative merits with respect to other formulations, equation 5 provides a ready means of determining $P_a \wedge P_b$ from a knowledge of r^2 and the respective unconditional probabilities at the two locations involved. Casting this function in terms of a CMSI by employing equation 2 points out relationships between the actual CMSI ($CMSI_t$) and that obtained by assuming independency ($CMSI_i$)

$$CMSI_t = 1 - P_a - (1 - r^2)(P_b - P_a P_b) \tag{6}$$

where $P_a > P_b$, or $CMSI_t = CMSI_i + P_b P_A r^2$

where $P_A = 1 - P_a$.

Note from the first equation in (6) that for $r^2 = 1$, the CMSI is equal to P_A or the unconditional probability of the station least likely to be above ceiling or visibility minimums. When r^2 is zero the CMSI is that attainable by the strict assumption of independency.

Computer tapes from ETAC (Asheville, N. C.) provided the raw data necessary to compute values for r^2 as a function of distance and time differential. The pairs of stations used and their respective separation distances are listed in figure 4.

Three ceiling and three visibility categories were processed, i.e., cig $<1000'$, $<500'$, $<200'$ and visibility < 3 mi, < 1 mi, $< 1/2$ mi for each of these stations and their complements (Mildenhall to Lakenheath and Lakenheath to Mildenhall for example) for time lags of 0, 3, and 6 hours for the four seasons of the year for the initial hours of 0000, 0600, 1200 and 1800 Local time. The resulting r^2-values were aligned as shown in figures 5 through 10.

The data for these tables were generated as follows: First ceiling and visibility unconditionals were read from data tapes and converted to r^2-values via equation 5. Next these magnitudes were plotted on graphs as a function of distance and analyzed using best fit regression curves. Finally r^2-values were read from these curves and plotted in tables similar to those in figures 5-10. The above technique, however, was found to yield inconsistent results for summer months and for low ceiling and visibility categories which were frequently based on data too sparse to be deemed reliable.

To bolster credibility in r^2 magnitudes several factors were considered:

1) The magnitude of P_b was examined to see whether r^2 was based on a substantial number of occurrences. When P_b is less than one or two percent r^2-values are highly fluctuative. Their absolute values have little significance since the values of $P_{a \wedge} P_b$ will in all likelihood either lie within the error range of the RUSSWO data or approach magnitudes given solely by chance.

2) Exponential functions were applied to test whether r^2-data decayed exponentially with respect to both time and distance. This caused only minor adjustments in data dense regions. It did, however, serve to establish an overall pattern or model for synthesizing r^2 variations as a function of time, distance and month.

3) In this research and also that reported in AFGL-TR-76-0249, it was found that monthly oscillations in r^2 and related parameters very closely

Station Data Processed to Obtain r^2 Values as a Function of Distance, Lag Time, and Category

Station Pairs	Distance in Kilometers
Mildenhall to Lakenheath and Lakenheath to Mildenhall	10
Andrews to Bolling and Bolling to Andrews	18
San Antonio to Kelly and Kelly to San Antonio	21
San Antonio to Randolph and Randolph to San Antonio	21
Randolph to Kelly and Kelly to Randolph	37
Waco to Ft. Hood and Ft. Hood to Waco	75
Corpus Christi to Victoria and Victoria to Corpus Christi	134
Waco to Dallas and Dallas to Waco	143
Victoria to Randolph and Randolph to Victoria	169
Victoria to San Antonio and San Antonio to Victoria	188
Randolph to Ft. Hood and Ft. Hood to Randolph	191
Victoria to Kelly and Kelly to Victoria	194
San Antonio to Ft. Hood and Ft. Hood to San Antonio	198
Dallas to Ft. Hood and Ft. Hood to Dallas	212
Ft. Hood to Kelly and Kelly to Ft. Hood	218
Corpus Christi to Randolph and Randolph to Corpus Christi	232
Corpus Christi to Kelly and Kelly to Corpus Christi	236
Corpus Christi to San Antonio and San Antonio to Corpus Christi	243
Waco to Randolph and Randolph to Waco	260
Waco to San Antonio and San Antonio to Waco	270
Victoria to Ft. Hood and Ft. Hood to Victoria	271
Lubbock to Abilene and Abilene to Lubbock	276
Abilene to Ft. Hood and Ft. Hood to Abilene	276
Waco to Kelly and Kelly to Waco	291
Abilene to Waco and Waco to Abilene	304
Waco to Victoria and Victoria to Waco	310
Abilene to Dallas and Dallas to Abilene	335
Abilene to San Antonio and San Antonio to Abilene	357
Abilene to Randolph and Randolph to Abilene	366
Abilene to Kelly and Kelly to Abilene	367
Corpus Christi to Ft. Hood and Ft. Hood to Corpus Christi	387
Dallas to Randolph and Randolph to Dallas	402
Dallas to San Antonio and San Antonio to Dallas	411
Dallas to Kelly and Kelly to Dallas	431
Waco to Corpus Christi and Corpus Christi to Waco	436
Dallas to Victoria and Victoria to Dallas	445

Fig. 4

r^2 Values for Ceilings $<$ 1000' with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	1.00	.88	.83	.78	.73	.69	.65	.61	.58	.54	.51	.48	.45	.43	.40	.38	.36	.34	.32	.30
Feb.	1.00	.87	.82	.76	.71	.67	.63	.59	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.30	.28
Mar.	1.00	.83	.77	.72	.66	.62	.57	.53	.50	.46	.43	.40	.37	.35	.32	.30	.28	.26	.24	.23
Apr.	1.00	.79	.72	.66	.60	.55	.50	.46	.42	.38	.35	.32	.29	.27	.24	.22	.20	.19	.17	.16
May	1.00	.75	.67	.60	.54	.48	.43	.39	.34	.30	.27	.24	.21	.19	.16	.14	.12	.12	.10	.09
June	1.00	.71	.62	.56	.49	.43	.37	.33	.28	.24	.21	.18	.15	.13	.10	.08	.06	.06	.04	.04
July	1.00	.70	.61	.54	.47	.41	.35	.31	.26	.22	.19	.16	.13	.11	.08	.06	.04	.04	.02	.02
Aug.	1.00	.71	.62	.56	.49	.43	.37	.33	.28	.24	.21	.18	.15	.13	.10	.08	.06	.06	.04	.04
Sept.	1.00	.75	.67	.60	.54	.48	.43	.39	.34	.30	.27	.24	.21	.19	.16	.14	.12	.12	.10	.09
Oct.	1.00	.79	.72	.66	.60	.55	.50	.46	.42	.38	.35	.32	.29	.27	.24	.20	.20	.19	.17	.16
Nov.	1.00	.83	.77	.72	.66	.62	.57	.53	.50	.46	.43	.40	.37	.35	.32	.30	.28	.26	.24	.23
Dec.	1.00	.87	.82	.76	.71	.67	.63	.59	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.30	.28

r^2 Values for Ceilings $<$ 1000' with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.74	.71	.68	.66	.63	.61	.58	.56	.54	.52	.50	.48	.46	.44	.42	.41	.39	.38	.36	.35
Feb.	.73	.70	.67	.65	.61	.59	.56	.54	.52	.50	.48	.46	.44	.42	.40	.39	.37	.36	.34	.33
Mar.	.71	.67	.64	.61	.57	.55	.51	.49	.47	.44	.42	.40	.37	.35	.33	.32	.30	.29	.28	.26
Apr.	.69	.64	.59	.55	.51	.48	.44	.41	.39	.36	.33	.31	.29	.27	.25	.23	.22	.20	.19	.18
May	.67	.61	.55	.49	.45	.42	.37	.33	.32	.28	.25	.22	.20	.19	.16	.14	.13	.11	.11	.09
June	.66	.59	.51	.45	.41	.37	.32	.28	.26	.22	.18	.16	.14	.12	.10	.07	.06	.04	.04	.03
July	.64	.57	.50	.44	.39	.35	.30	.26	.24	.20	.16	.14	.12	.10	.08	.05	.04	.02	.02	.01
Aug.	.66	.59	.51	.45	.41	.37	.32	.28	.26	.22	.18	.16	.14	.12	.10	.07	.06	.04	.04	.03
Sept.	.67	.61	.55	.49	.45	.42	.37	.33	.32	.28	.25	.22	.20	.19	.16	.14	.13	.11	.11	.09
Oct.	.69	.64	.59	.55	.51	.48	.44	.41	.39	.36	.33	.31	.29	.27	.25	.23	.22	.20	.19	.18
Nov.	.71	.67	.64	.61	.57	.55	.51	.49	.47	.44	.42	.40	.37	.35	.33	.32	.30	.29	.28	.26
Dec.	.73	.70	.67	.65	.61	.59	.56	.54	.52	.50	.48	.46	.44	.42	.40	.39	.37	.36	.34	.33

r^2 Values for Ceilings $<$ 1000' with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	280
Jan.	.60	.58	.56	.55	.53	.52	.50	.49	.48	.46	.45	.44	.43	.41	.40	.39	.38	.37	.36	.35
Feb.	.60	.57	.55	.54	.52	.51	.48	.47	.46	.44	.43	.42	.41	.39	.38	.37	.36	.35	.34	.33
Mar.	.58	.55	.52	.50	.48	.46	.44	.42	.41	.39	.37	.36	.35	.33	.31	.30	.29	.28	.27	.26
Apr.	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.30	.28	.26	.25	.23	.22	.21	.19	.18	.17
May	.54	.49	.45	.42	.38	.35	.32	.30	.27	.25	.22	.20	.17	.16	.14	.13	.12	.11	.09	.08
June	.51	.47	.43	.38	.34	.31	.28	.25	.22	.20	.17	.14	.11	.10	.08	.07	.06	.04	.02	.02
July	.51	.46	.42	.37	.33	.30	.26	.23	.20	.18	.15	.12	.09	.08	.06	.05	.04	.02	.00	.00
Aug.	.51	.47	.43	.38	.34	.31	.28	.25	.22	.20	.17	.14	.11	.10	.08	.07	.06	.04	.02	.02
Sept.	.54	.49	.45	.42	.38	.35	.32	.30	.27	.25	.22	.20	.17	.16	.14	.13	.12	.11	.09	.08
Oct.	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.30	.28	.26	.25	.23	.22	.21	.19	.18	.17
Nov.	.58	.55	.52	.50	.48	.46	.44	.42	.41	.39	.37	.36	.35	.33	.31	.30	.29	.28	.27	.26
Dec.	.60	.57	.55	.54	.52	.51	.48	.47	.46	.44	.43	.42	.41	.39	.38	.37	.36	.35	.34	.33

Fig. 5

r^2 Values for Ceilings ∠500' with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	1.00	.81	.74	.68	.64	.58	.54	.50	.47	.43	.41	.38	.36	.34	.29	.26	.23	.22	.19	.17
Feb.	1.00	.80	.72	.66	.61	.55	.50	.46	.43	.39	.36	.33	.31	.30	.26	.22	.20	.18	.16	.14
Mar.	1.00	.79	.70	.63	.58	.51	.46	.42	.38	.35	.31	.28	.26	.25	.22	.17	.15	.14	.13	.11
Apr.	1.00	.77	.67	.58	.52	.44	.38	.34	.30	.27	.23	.19	.17	.16	.15	.11	.08	.07	.06	.05
May	1.00	.76	.64	.53	.46	.37	.30	.26	.22	.19	.15	.10	.08	.07	.06	.05	.01	.00	.00	.00
June	1.00	.75	.62	.50	.42	.33	.26	.22	.17	.15	.10	.05	.04	.03	.03	.03	.00	.00	.00	.00
July	1.00	.73	.60	.48	.40	.30	.22	.18	.13	.11	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	1.00	.74	.62	.50	.42	.33	.26	.22	.17	.15	.10	.05	.04	.03	.03	.03	.00	.00	.00	.00
Sept.	1.00	.75	.64	.53	.46	.37	.30	.26	.22	.19	.15	.10	.08	.07	.06	.05	.01	.00	.00	.00
Oct.	1.00	.77	.67	.58	.52	.44	.38	.34	.30	.27	.23	.19	.17	.16	.15	.11	.08	.07	.06	.05
Nov.	1.00	.79	.70	.63	.58	.51	.46	.42	.38	.35	.31	.28	.26	.25	.22	.17	.15	.14	.13	.11
Dec.	1.00	.80	.72	.66	.61	.55	.50	.46	.43	.39	.36	.33	.31	.30	.26	.22	.20	.18	.16	.14

r^2 Values for Ceilings ∠500' with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.68	.62	.58	.55	.52	.50	.47	.44	.42	.39	.38	.36	.34	.32	.30	.29	.27	.25	.24	.23
Feb.	.67	.61	.57	.53	.50	.48	.45	.42	.39	.36	.35	.33	.31	.29	.27	.26	.25	.23	.22	.21
Mar.	.64	.57	.52	.48	.45	.41	.38	.35	.33	.30	.28	.26	.24	.22	.20	.19	.18	.16	.15	.14
Apr.	.61	.52	.47	.41	.37	.32	.29	.26	.23	.20	.18	.16	.14	.13	.11	.10	.09	.08	.07	.06
May	.58	.47	.42	.34	.30	.23	.20	.17	.14	.15	.09	.08	.07	.06	.05	.05	.04	.04	.03	.03
June	.55	.43	.37	.29	.24	.16	.13	.10	.07	.04	.03	.03	.03	.02	.02	.01	.00	.00	.00	.00
July	.54	.42	.36	.27	.22	.14	.11	.08	.04	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.55	.43	.37	.29	.24	.16	.13	.10	.07	.04	.03	.03	.03	.02	.02	.01	.00	.00	.00	.00
Sept.	.58	.47	.42	.34	.30	.23	.20	.17	.14	.15	.09	.08	.07	.06	.05	.05	.04	.04	.03	.03
Oct.	.61	.52	.47	.41	.37	.32	.29	.26	.23	.20	.18	.16	.14	.13	.11	.10	.09	.08	.07	.06
Nov.	.64	.57	.52	.48	.45	.41	.38	.35	.33	.30	.28	.26	.24	.22	.20	.19	.18	.16	.15	.14
Dec.	.67	.61	.57	.53	.50	.48	.45	.42	.39	.36	.35	.33	.31	.29	.27	.26	.25	.23	.22	.21

r^2 Values for Ceilings ∠500' with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.52	.47	.45	.43	.42	.40	.39	.38	.37	.35	.34	.33	.31	.30	.29	.28	.27	.26	.25	.24
Feb.	.49	.45	.43	.41	.40	.38	.37	.35	.34	.32	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21
Mar.	.46	.41	.38	.36	.34	.32	.30	.28	.27	.26	.24	.23	.22	.21	.20	.18	.17	.16	.15	.15
Apr.	.40	.35	.32	.29	.26	.24	.21	.19	.18	.16	.14	.13	.12	.11	.10	.09	.08	.07	.06	.06
May	.34	.29	.25	.22	.18	.16	.12	.09	.09	.08	.07	.07	.06	.06	.05	.05	.04	.04	.03	.03
June	.31	.26	.21	.17	.12	.10	.05	.03	.03	.03	.02	.02	.02	.01	.01	.01	.01	.01	.00	.00
July	.28	.23	.19	.15	.10	.08	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.31	.26	.21	.17	.12	.10	.05	.03	.03	.03	.02	.02	.02	.01	.01	.01	.01	.01	.00	.00
Sept.	.34	.29	.25	.22	.18	.16	.12	.09	.09	.08	.07	.07	.06	.06	.05	.05	.04	.04	.03	.03
Oct.	.40	.35	.32	.29	.26	.24	.21	.19	.18	.16	.14	.13	.12	.11	.10	.09	.08	.07	.06	.06
Nov.	.46	.41	.38	.36	.34	.32	.30	.28	.27	.26	.24	.23	.22	.21	.20	.18	.17	.16	.15	.15
Dec.	.49	.45	.43	.41	.40	.38	.37	.35	.34	.32	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21

Fig. 6

r^2 Values for Ceilings $<$200' with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.87	.77	.67	.59	.52	.45	.39	.35	.30	.26	.23	.20	.18	.15	.14	.12	.10	.09	.08	.07
Feb.	.85	.76	.65	.57	.50	.48	.37	.33	.28	.24	.21	.18	.16	.14	.13	.11	.09	.08	.07	.06
Mar.	.83	.72	.60	.51	.43	.36	.30	.26	.22	.18	.16	.13	.12	.10	.09	.07	.06	.05	.05	.04
Apr.	.80	.67	.54	.43	.35	.28	.22	.18	.14	.12	.09	.07	.06	.05	.04	.03	.02	.02	.02	.01
May	.77	.62	.48	.35	.27	.20	.18	.10	.07	.06	.05	.04	.03	.03	.02	.02	.01	.01	.01	.00
June	.75	.58	.43	.29	.20	.13	.07	.03	.02	.02	.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
July	.73	.57	.41	.27	.18	.11	.05	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.75	.58	.43	.29	.20	.13	.07	.03	.02	.02	.01	.01	.01	.01	.01	.00	.00	.00	.00	.C0
Sept.	.77	.62	.48	.35	.27	.20	.18	.10	.07	.06	.05	.04	.03	.03	.02	.02	.01	.01	.01	.00
Oct.	.80	.67	.54	.43	.35	.28	.22	.18	.14	.12	.09	.07	.06	.05	.04	.03	.02	.02	.02	.01
Nov.	.83	.72	.60	.51	.43	.36	.30	.26	.22	.18	.16	.13	.12	.10	.09	.07	.06	.05	.05	.04
Dec.	.85	.76	.65	.57	.50	.43	.37	.33	.28	.24	.21	.18	.16	.14	.13	.11	.09	.08	.07	.06

r^2 Values for Ceilings $<$200' with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.58	.53	.48	.43	.39	.35	.31	.28	.25	.22	.20	.18	.16	.15	.13	.12	.10	.09	.08	.08
Feb.	.56	.51	.46	.41	.37	.33	.29	.26	.23	.20	.18	.16	.15	.14	.12	.11	.09	.08	.07	.07
Mar.	.53	.47	.42	.35	.31	.27	.24	.20	.18	.15	.13	.12	.11	.10	.08	.07	.06	.06	.05	.04
Apr.	.49	.41	.34	.28	.23	.19	.16	.13	.11	.09	.07	.06	.05	.04	.03	.03	.02	.02	.01	.01
May	.46	.35	.27	.20	.15	.11	.08	.07	.06	.05	.03	.03	.02	.02	.02	.01	.01	.01	.01	.00
June	.43	.31	.22	.15	.09	.05	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00
July	.40	.29	.20	.13	.07	.03	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.43	.31	.22	.15	.09	.05	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.99
Sept.	.46	.35	.27	.20	.15	.11	.08	.07	.06	.05	.03	.03	.02	.02	.02	.01	.01	.01	.01	.00
Oct.	.49	.41	.34	.28	.23	.19	.16	.13	.11	.09	.07	.06	.05	.04	.03	.03	.02	.02	.01	.01
Nov.	.53	.47	.42	.35	.31	.27	.24	.20	.18	.15	.13	.12	.11	.10	.08	.07	.06	.06	.05	.04
Dec.	.56	.51	.46	.41	.37	.33	.29	.26	.23	.20	.18	.16	.15	.14	.12	.11	.09	.08	.07	.07

r^2 Values for Ceilings $<$200' with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.40	.37	.34	.31	.29	.26	.24	.22	.20	.19	.17	.16	.14	.13	.12	.11	.10	.09	.08	.07
Feb.	.38	.36	.33	.29	.27	.24	.22	.20	.18	.17	.15	.15	.13	.12	.11	.10	.09	.08	.07	.06
Mar.	.35	.31	.28	.24	.22	.20	.17	.15	.14	.12	.11	.10	.09	.08	.08	.07	.06	.05	.05	.04
Apr.	.31	.26	.22	.18	.15	.13	.11	.09	.08	.06	.05	.05	.04	.03	.03	.02	.02	.02	.01	.01
May	.27	.20	.16	.12	.08	.07	.05	.05	.04	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00
June	.25	.16	.11	.07	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
July	.22	.15	.10	.05	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.25	.16	.11	.07	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
Sept.	.27	.20	.16	.12	.08	.07	.05	.05	.04	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00
Oct.	.31	.26	.22	.18	.15	.13	.11	.09	.08	.06	.05	.05	.04	.03	.03	.02	.02	.02	.01	.01
Nov.	.35	.31	.28	.24	.22	.20	.17	.15	.14	.12	.11	.10	.09	.08	.08	.07	.06	.05	.05	.04
Dec.	.38	.36	.33	.29	.27	.24	.22	.20	.18	.17	.15	.15	.13	.12	.11	.10	.09	.08	.07	.06

Fig. 7

r^2 Values for Visibilities $\angle$3 Miles with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	1.00	.78	.73	.68	.63	.59	.55	.51	.48	.44	.41	.40	.36	.34	.31	.29	.27	.25	.24	.22
Feb.	1.00	.77	.72	.67	.62	.57	.53	.49	.46	.42	.40	.37	.34	.32	.30	.27	.25	.23	.22	.20
Mar.	1.00	.76	.70	.65	.60	.55	.51	.47	.44	.40	.37	.34	.32	.30	.27	.25	.23	.21	.20	.18
Apr.	1.00	.75	.68	.63	.57	.52	.48	.44	.40	.37	.34	.31	.28	.26	.23	.21	.20	.18	.16	.15
May	1.00	.74	.66	.61	.54	.49	.45	.41	.36	.34	.31	.27	.24	.22	.19	.17	.16	.15	.12	.11
June	1.00	.73	.64	.59	.52	.47	.44	.39	.34	.32	.29	.25	.22	.20	.17	.15	.14	.12	.10	.09
July	1.00	.72	.63	.58	.51	.45	.43	.37	.32	.30	.27	.23	.20	.18	.15	.13	.12	.10	.08	.07
Aug.	1.00	.73	.64	.59	.52	.47	.44	.39	.34	.32	.29	.25	.22	.20	.17	.15	.14	.12	.10	.09
Sept.	1.00	.74	.66	.61	.54	.49	.45	.41	.36	.34	.31	.27	.24	.22	.19	.17	.16	.15	.12	.11
Oct.	1.00	.75	.68	.63	.57	.52	.48	.44	.40	.37	.34	.31	.28	.26	.23	.21	.20	.18	.16	.15
Nov.	1.00	.76	.70	.65	.60	.55	.51	.47	.44	.40	.37	.34	.32	.30	.27	.25	.23	.21	.20	.18
Dec.	1.00	.77	.72	.67	.62	.57	.53	.49	.46	.42	.40	.37	.34	.32	.30	.27	.25	.23	.22	.20

r^2 Values for Visibilities $\angle$ 3 Miles with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.76	.65	.61	.58	.54	.52	.49	.46	.43	.41	.38	.36	.34	.32	.30	.29	.27	.25	.24	.23
Feb.	.74	.62	.60	.56	.52	.50	.47	.44	.41	.39	.36	.34	.32	.31	.29	.28	.26	.24	.23	.22
Mar.	.71	.60	.55	.52	.48	.45	.43	.40	.37	.35	.32	.30	.28	.26	.25	.23	.21	.20	.19	.18
Apr.	.62	.54	.50	.46	.42	.39	.36	.33	.31	.28	.26	.24	.22	.21	.19	.18	.16	.15	.14	.13
May	.55	.52	.45	.40	.36	.33	.30	.26	.25	.21	.20	.18	.16	.15	.13	.12	.11	.10	.09	.08
June	.51	.46	.40	.36	.32	.28	.25	.22	.21	.17	.16	.14	.12	.11	.09	.08	.06	.06	.05	.04
July	.49	.43	.39	.34	.30	.26	.23	.20	.19	.15	.14	.12	.10	.10	.08	.07	.05	.05	.04	.03
Aug.	.51	.46	.40	.36	.32	.28	.25	.22	.21	.17	.16	.14	.12	.11	.09	.08	.06	.06	.05	.04
Sept.	.55	.52	.45	.40	.36	.33	.30	.26	.25	.21	.20	.18	.16	.15	.13	.12	.11	.10	.09	.08
Oct.	.62	.54	.50	.46	.42	.39	.36	.33	.31	.28	.26	.24	.22	.21	.19	.18	.16	.15	.14	.13
Nov.	.71	.60	.55	.52	.48	.45	.43	.40	.37	.35	.32	.30	.28	.26	.25	.23	.21	.20	.19	.18
Dec.	.74	.62	.60	.56	.52	.50	.47	.44	.41	.39	.36	.34	.32	.31	.29	.28	.26	.24	.23	.22

r^2 Values for Visibilities $\angle$3 Miles with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.62	.54	.52	.49	.47	.44	.42	.40	.38	.36	.35	.33	.31	.30	.28	.27	.26	.24	.23	.22
Feb.	.58	.51	.50	.47	.45	.42	.40	.38	.36	.34	.33	.31	.29	.28	.26	.25	.24	.22	.21	.20
Mar.	.53	.46	.44	.41	.39	.37	.35	.33	.30	.28	.27	.26	.24	.23	.21	.20	.19	.18	.17	.16
Apr.	.44	.39	.36	.33	.31	.29	.27	.25	.23	.21	.20	.19	.17	.16	.15	.14	.13	.12	.11	.10
May	.35	.32	.28	.25	.23	.21	.19	.17	.15	.13	.12	.12	.10	.09	.08	.07	.06	.06	.05	.05
June	.30	.28	.22	.19	.17	.16	.14	.12	.10	.08	.07	.06	.05	.04	.04	.03	.02	.02	.01	.01
July	.26	.24	.20	.17	.15	.14	.12	.10	.08	.06	.05	.05	.03	.02	.02	.01	.00	.00	.00	.00
Aug.	.30	.28	.22	.19	.17	.16	.14	.12	.10	.08	.07	.06	.05	.04	.04	.03	.02	.02	.01	.01
Sept.	.35	.32	.28	.25	.23	.21	.19	.17	.15	.13	.12	.12	.10	.09	.08	.07	.06	.06	.05	.05
Oct.	.44	.39	.36	.33	.31	.29	.27	.25	.23	.21	.20	.19	.17	.16	.15	.14	.13	.12	.11	.10
Nov.	.53	.46	.44	.41	.39	.37	.35	.33	.30	.28	.27	.26	.24	.23	.21	.20	.19	.18	.17	.16
Dec.	.58	.51	.50	.47	.45	.42	.40	.38	.36	.34	.33	.31	.29	.28	.26	.25	.24	.22	.21	.20

Fig. 8

r^2 Values for Visibilities < 1 Mile with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	1.00	.72	.66	.60	.55	.50	.46	.42	.38	.35	.32	.29	.27	.24	.22	.20	.19	.17	.16	.14
Feb.	1.00	.70	.63	.58	.52	.47	.43	.39	.35	.32	.29	.26	.24	.21	.19	.17	.16	.14	.14	.12
Mar.	1.00	.68	.60	.54	.48	.42	.38	.34	.30	.27	.25	.21	.19	.17	.15	.14	.13	.11	.11	.10
Apr.	1.00	.64	.55	.48	.41	.35	.30	.26	.22	.19	.17	.14	.12	.11	.09	.08	.07	.06	.06	.05
May	1.00	.60	.50	.42	.33	.28	.22	.18	.14	.11	.09	.07	.05	.05	.03	.02	.01	.00	.00	.00
June	1.00	.58	.47	.39	.30	.24	.18	.14	.09	.07	.05	.04	.03	.02	.02	.01	.00	.00	.00	.00
July	1.00	.56	.44	.36	.27	.20	.14	.10	.06	.02	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	1.00	.58	.47	.39	.30	.24	.18	.14	.09	.07	.05	.04	.03	.02	.02	.01	.00	.00	.00	.00
Sept.	1.00	.60	.50	.42	.33	.28	.22	.18	.14	.11	.09	.07	.05	.05	.03	.02	.01	.00	.00	.00
Oct.	1.00	.64	.55	.48	.41	.35	.30	.26	.22	.19	.17	.14	.12	.11	.09	.08	.07	.06	.06	.05
Nov.	1.00	.68	.60	.54	.48	.42	.38	.34	.30	.27	.25	.21	.19	.17	.15	.14	.13	.11	.11	.10
Dec.	1.00	.70	.63	.58	.52	.47	.43	.39	.35	.32	.29	.26	.24	.21	.19	.17	.16	.14	.14	.12

r^2 Values for Visibilities < 1 Mile with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.56	.50	.46	.43	.39	.36	.34	.31	.29	.26	.24	.23	.21	.19	.18	.16	.15	.14	.13	.12
Feb.	.53	.47	.44	.41	.37	.34	.32	.29	.27	.24	.22	.21	.19	.17	.16	.15	.14	.13	.12	.11
Mar.	.48	.43	.38	.35	.32	.29	.26	.24	.21	.19	.17	.16	.14	.13	.12	.11	.10	.09	.08	.07
Apr.	.41	.36	.31	.27	.24	.21	.18	.16	.14	.12	.10	.09	.08	.07	.06	.05	.04	.04	.03	.03
May	.34	.29	.23	.19	.16	.13	.10	.09	.07	.06	.05	.05	.04	.04	.03	.03	.02	.02	.02	.01
June	.29	.25	.18	.13	.11	.08	.04	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00
July	.26	.22	.16	.11	.09	.06	.02	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.29	.25	.18	.13	.11	.08	.04	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00
Sept.	.34	.29	.23	.19	.16	.13	.10	.09	.07	.06	.05	.05	.04	.04	.03	.03	.02	.02	.02	.01
Oct.	.41	.36	.31	.27	.24	.21	.18	.16	.14	.12	.10	.09	.08	.07	.06	.05	.04	.04	.03	.03
Nov.	.48	.43	.38	.35	.32	.29	.26	.24	.21	.19	.17	.16	.14	.13	.12	.11	.10	.09	.08	.07
Dec.	.53	.47	.44	.41	.37	.34	.32	.29	.27	.24	.22	.21	.19	.17	.16	.15	.14	.13	.12	.11

r^2 Values for Visibilities < 1 Mile with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.40	.35	.33	.29	.26	.25	.23	.21	.20	.19	.17	.16	.15	.14	.13	.12	.11	.11	.10	.09
Feb.	.37	.32	.31	.27	.24	.23	.21	.19	.18	.17	.16	.15	.14	.13	.12	.11	.10	.10	.09	.08
Mar.	.32	.27	.26	.23	.20	.18	.17	.15	.14	.13	.11	.10	.10	.09	.08	.07	.07	.07	.06	.05
Apr.	.24	.20	.18	.16	.14	.12	.11	.09	.08	.07	.06	.05	.05	.04	.04	.03	.03	.02	.02	.01
May	.16	.13	.10	.09	.08	.06	.06	.05	.04	.04	.03	.03	.02	.02	.02	.02	.01	.01	.01	.00
June	.11	.08	.05	.05	.04	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
July	.08	.05	.03	.03	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.11	.08	.05	.05	.04	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sept.	.16	.13	.10	.09	.08	.06	.06	.05	.04	.04	.03	.03	.02	.02	.02	.02	.01	.01	.01	.00
Oct.	.24	.20	.18	.16	.14	.12	.11	.09	.08	.07	.06	.05	.05	.04	.04	.03	.03	.02	.02	.01
Nov.	.32	.27	.26	.23	.20	.18	.17	.15	.14	.13	.11	.10	.10	.09	.08	.07	.07	.07	.06	.05
Dec.	.37	.32	.31	.27	.24	.23	.21	.19	.18	.17	.16	.15	.14	.13	.12	.11	.10	.10	.09	.08

Fig. 9

r^2 Values for Visibilities < 1/2 Mile with 0-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.74	.66	.58	.52	.46	.41	.36	.32	.28	.25	.22	.20	.18	.16	.14	.12	.11	.10	.09	.08
Feb.	.74	.64	.55	.48	.41	.36	.31	.27	.24	.21	.18	.17	.15	.13	.12	.10	.09	.08	.07	.06
Mar.	.74	.62	.51	.43	.35	.30	.25	.20	.18	.15	.13	.12	.11	.09	.08	.06	.05	.04	.04	.03
Apr.	.74	.59	.44	.34	.25	.19	.15	.11	.08	.06	.05	.04	.03	.02	.02	.01	.00	.00	.00	.00
May	.74	.56	.37	.25	.15	.08	.05	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
June	.74	.54	.33	.20	.09	.03	.02	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
July	.74	.52	.30	.16	.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.74	.54	.33	.20	.09	.03	.02	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sept.	.74	.56	.37	.25	.15	.08	.05	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Oct.	.74	.59	.44	.34	.25	.19	.15	.11	.08	.06	.05	.04	.03	.02	.02	.01	.00	.00	.00	.00
Nov.	.74	.62	.51	.43	.35	.30	.25	.20	.18	.15	.13	.12	.11	.01	.08	.06	.05	.04	.04	.03
Dec.	.74	.64	.55	.48	.41	.36	.31	.27	.24	.21	.18	.17	.15	.13	.12	.10	.09	.08	.07	.06

r^2 Values for Visibilities < 1/2 Mile with 3-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.52	.46	.41	.37	.33	.30	.26	.24	.21	.19	.17	.15	.14	.12	.11	.10	.09	.08	.07	.06
Feb.	.50	.43	.39	.35	.31	.27	.24	.22	.19	.17	.15	.13	.12	.11	.10	.09	.08	.07	.06	.05
Mar.	.46	.39	.33	.28	.24	.20	.17	.15	.13	.12	.10	.08	.07	.07	.06	.06	.05	.04	.03	.03
Apr.	.41	.33	.25	.19	.15	.11	.09	.07	.05	.04	.03	.02	.02	.01	.01	.01	.00	.00	.00	.00
May	.36	.27	.17	.15	.08	.06	.05	.04	.03	.02	.02	.01	.01	.01	.01	.00	.00	.00	.00	.00
June	.31	.23	.11	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
July	.28	.20	.09	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.31	.23	.11	.03	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sept.	.36	.27	.17	.15	.08	.06	.05	.04	.03	.02	.02	.01	.01	.01	.01	.00	.00	.00	.00	.00
Oct.	.41	.33	.25	.19	.15	.11	.09	.07	.05	.04	.03	.02	.02	.01	.01	.01	.00	.00	.00	.00
Nov.	.46	.39	.33	.28	.24	.20	.17	.15	.13	.12	.10	.08	.07	.07	.06	.06	.05	.04	.03	.03
Dec.	.50	.43	.39	.35	.31	.27	.24	.22	.19	.17	.15	.13	.12	.11	.10	.09	.08	.07	.06	.05

r^2 Values for Visibilities < 1/2 Mile with 6-Hr Time Differential

Route Distance in Air Kilometers

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Jan.	.36	.32	.29	.26	.23	.21	.18	.17	.15	.13	.12	.11	.10	.09	.08	.07	.06	.06	.05	.04
Feb.	.33	.29	.27	.24	.21	.19	.16	.15	.13	.12	.11	.10	.09	.08	.07	.06	.05	.05	.04	.03
Mar.	.29	.25	.22	.19	.16	.14	.12	.10	.09	.07	.07	.06	.06	.05	.05	.04	.03	.03	.02	.02
Apr.	.22	.19	.15	.11	.09	.07	.05	.04	.03	.02	.02	.01	.01	.01	.01	.00	.00	.00	.00	.00
May	.15	.11	.08	.06	.05	.04	.03	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
June	.11	.07	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
July	.08	.04	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Aug.	.11	.07	.03	.02	.02	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sept.	.15	.11	.08	.06	.05	.04	.03	.02	.02	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
Oct.	.22	.19	.15	.11	.09	.07	.05	.04	.03	.02	.02	.01	.01	.01	.01	.00	.00	.00	.00	.00
Nov.	.29	.25	.22	.19	.16	.14	.12	.10	.09	.07	.07	.06	.06	.05	.05	.04	.03	.03	.02	.02
Dec.	.33	.29	.27	.24	.21	.19	.16	.15	.13	.12	.11	.10	.09	.08	.07	.06	.05	.05	.04	.03

Fig. 10

resemble that of a cosine function. Hence our data were further subjected to this restraint to enhance their reliability. The mean value of the cosine function is actually an annual mean which was found to be representative of the two transition months, namely April and October. The amplitude of the cosine function represents the decay in r^2 from January to April (or April to July, July to October or October to January).

The advantages of employing the cosine representation are many fold:

1) The reliability of the r^2- value for a given month becomes enhanced when made to fit in a cosine pattern with all the other months.

2) The data from figures 5- 10 can be represented by a limited number of analytic functions by expressing the monthly oscillation as a cosine function.

One can take advantage of the fact that r^2 relies more heavily on the lower of the two respective unconditionals to obtain "ball-park estimates" of conditional probabilities for locations where unconditional probabilities are not available. This is especially true in those cases where meteorological evidence would infer that the unknown unconditional probabilities should be equal to or higher than those of a neighboring station where unconditional probabilities and the current weather are known. From the relationships,

$$P_1 \wedge P_2 = P(1,2) = P(2/1)\,(P_1) \qquad (7)$$

it follows that

$$P(2/1) = \frac{P_1 \wedge P_2}{P_1} .$$

But $P_1 \wedge P_2 = r^2\, P_b + (1 - r^2)\, P_1\, P_2$ from equation 5 where P_b is the smaller of P_1 and P_2. The term $r^2\, P_b$ is generally much greater than $(1 - r^2)\, P_1\, P_2$ whenever r^2 is large. In such cases $P_1 \wedge P_2 \approx r^2 P_b$. Substituting this value into equation 7 gives $P(2/1) \approx \frac{r^2\, P_b}{P_1}$. It follows that : (1) When $P_1 \leq P_2$, $r^2 \approx P(2/1)$.

(2) When $P_2 < P_1$, r^2 tends to overestimate the conditional probability since the magnitude of the ratio between P_2 and P_1 is less than one in the equation $P(2/1) \approx r^2\, \frac{P_2}{P_1}$.

V. EXPRESSING TIME AND SPACE VARIATIONS IN r^2 BY ANALYTIC FORMULATIONS

Formulae for modelling the r^2-values of figure 5 through 10 are presented in figure 11. The data of figures 5 through 10 show that r^2-values for separation distances in excess of 20 kilometers, in general, followed a different exponential curve than those ranging between 0 and 20 kilometers. Hence, we formulated the equations about the 20 kilometer value with zero lag and logarithmically "extrapolated" forwards in distance and time from that point for distances in excess of 20 km. For those distances less than 20 km, a linear interpolation between the 20 km and 0 km values is made.

For illustration purposes consider the formulae in figure 11 for ∠ 200'.

$$\text{Jan:} \quad r^2 = e^{-\left[.26 + .12t + .0067\,(S-20)\, e^{-.07t}\right]} \qquad \text{for } S \geq 20$$

$$\text{April:} \quad r^2 = e^{-\left[.40 + .16t + .01\,(S-20)\, e^{-.04t}\right]} \qquad (8)$$

The first term in the exponent of each equation sets the starting point by specifying the power to which e must be raised to give r^2 at 20 km if no time lag is involved. I.e., $e^{-.26} = .77$ and $e^{-.40} = .67$ (the magnitudes given for r^2 in figure 7 for 20 km, 0-time lag during January and April respectively).

The next term adjusts r^2 to account for time lags between stations. For example, at 20 km and 3-hr time lag, $r^2 = e^{-.62} = .53$ in January and $r^2 = e^{-.88} = .41$ in April (See Fig. 7).

Finally r^2 is adjusted for distances other than 20 km by the last portion of each expression. For a separation distance of 160 km and 3-hr time lag, our equations would give $r^2 = e^{-1.38} = .25$ in January and $r^2 = {}^{-2.24} = .11$ in April as indicated by Figure 7.

The difference between January and April's r^2-values calculated for any point with respect to distance and time differential defines the amplitude (A) of the cosine terms for determining r^2-values for other months at that same point, i.e.,

r^2-value for Feb. and Dec. = April's r^2-value + .866A
r^2- value for March and Nov. = April's r2-value + .5A
r^2-value for October = April's r^2-value + .0A
r^2-value for May and Sept. = April's r^2-value - .5A
r^2-value for June and August = April's r^2-value - .866A
r^2-value for July = April's r^2-value - 1.00A

Analytic Formulations of the Data
Figures 5 Through 10

Category		Formulae
Ceilings $< 1000'$		
January:		$r^2 = e^{-\left[.13 + .07t + .003(S-20)\, e^{-.13t}\right]}$
April or October:		$r^2 = e^{-\left[.24 + .07t + .0045(S-20)\, e^{-.07t}\right]}$
Ceilings $< 500'$		
January:		$r^2 = e^{-\left[.21 + .09t + .004(S-20)\, e^{-.12t}\right]}$
April or October:		$r^2 = e^{-\left[.26 + .13t + .007(S-20)\, e^{-.06t}\right]}$
Ceilings $< 200'$		
January:		$r^2 = e^{-\left[.26 + .12t + .0067(S-20)\, e^{-.07t}\right]}$
April or October:		$r^2 = e^{-\left[.40 + .16t + .011(S-20)\, e^{-.04t}\right]}$
Visibility < 3 Miles		
January:		$r^2 = e^{-\left[.25 + .06t + .0034(S-20)\, e^{-.05t}\right]}$
April or October:		$r^2 = e^{-\left[.29 + .11t + .0044(S-20)\, e^{-.03t}\right]}$
Visibility < 1 Mile		
January:		$r^2 = e^{-\left[.33 + .12t + .0045(S-20)\, e^{-.04t}\right]}$
April or October:		$r^2 = e^{-\left[.45 + .19t + .0075(S-20)\, e^{-.02t}\right]}$
Visibility $< \frac{1}{2}$ Mile		
January:		$r^2 = e^{-\left[.42 + .12t + .006(S-20)\, e^{-.03t}\right]}$
April or October:		$r^2 = e^{-\left[.53 + .19t + .014(S-20)\, e^{-.01t}\right]}$

Fig. 11

Values of r^2 for ceilings deduced by these formulae (or read directly from figures 5 through 7) and those similarly deduced for visibilities (or extracted from figures 8 through 10) permit the calculation of the corresponding $CMSI_t$ values using equation 6. These $CMSI_t$ values for ceiling and visibility respectively can then be inserted for $(1 - P_a)$ and $1 - P_b)$ in equation 4 to obtain $CMSI_t$'s for joint ceiling and visibility occurrences.

Figure 12 is designed to link individual values of r^2 for ceiling and r^2 for visibility with the appropriate r^2 for ceiling and visibility combined. It provides a powerful link between the work of this contract and that reported on in AFGL-TR-76-0249 since it is a straightforward procedure to convert B-factors of figure 1 into r^2 terms. The conversion is

$$r^2 = 1 - \frac{B}{P_A} . \qquad (9)$$

Thus, an independent verification of many of the r^2-values of figures 5 through 10 was achieved by using the graph in figure 12 and the data of those figures to estimate joint probability values for comparison with the converted B-factor data of figure 13.

The above research provides a means of modelling all terms in the three station problem except the last one in the equation

$$CMSI_{3\ stations} = 1 - P_a - P_b - P_c + P_{a \wedge} P_b + P_{a \wedge} P_c + P_{b \wedge} P_c \qquad (10)$$

$$- P_{a \wedge} P_{b \wedge} P_c .$$

We do not envision any difficulties in modelling the last term, as well, since Lund and Grantham have presented allied procedures which pertain to any desired number of joint probabilities. We have already modified our two station procedures to this end and are gathering the necessary statistics for verification.

VI. COMPACTING THE RUSSWO DATA FOR CEILINGS AND VISIBILITIES

Some procedures for compacting the unconditional probabilities for ceilings and visibilities (either considered separately or in combination) are found in AFGL-TR-76-0249.

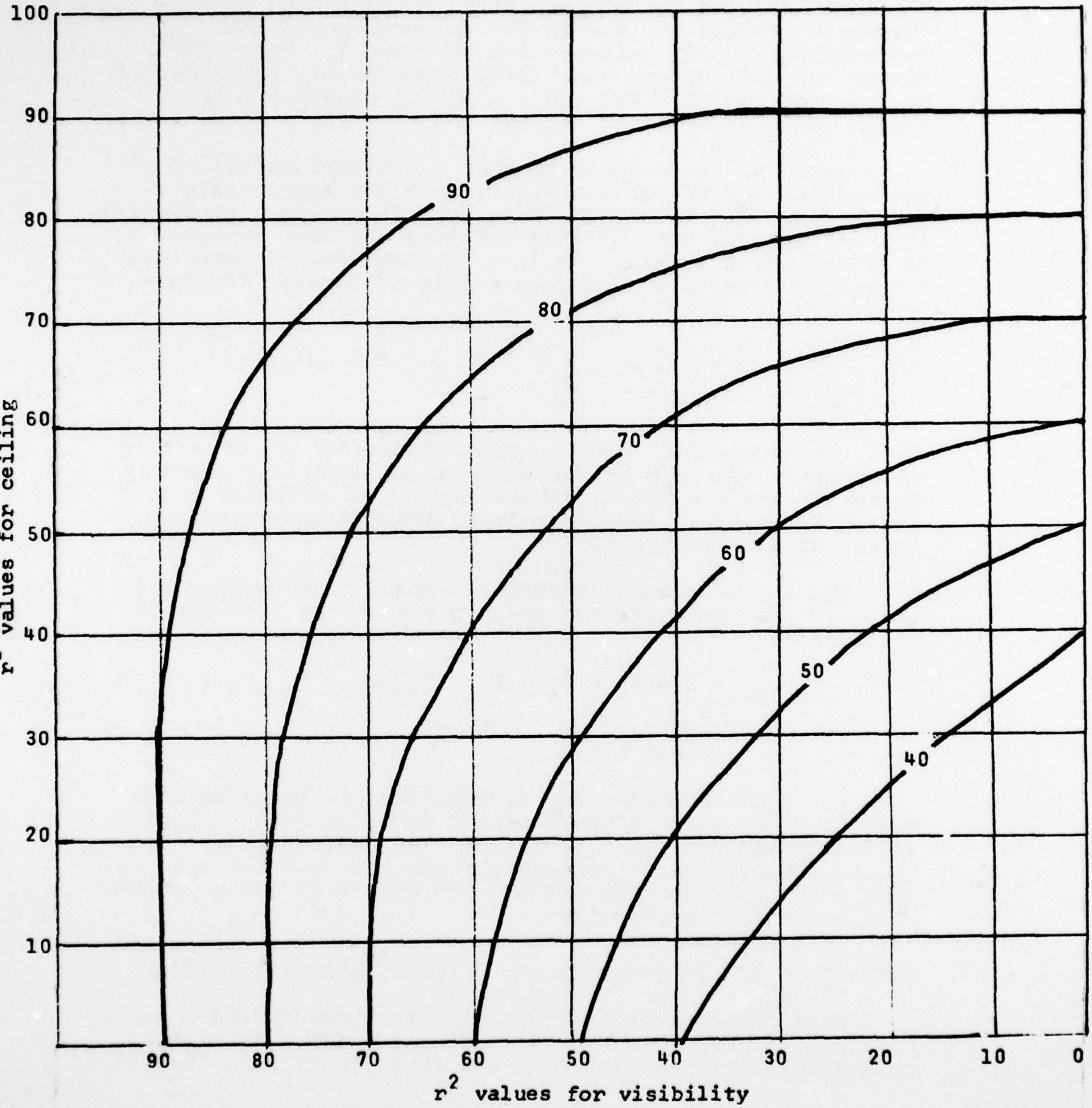

Fig. 12. r^2 values for joint ceiling and visibility categories

r^2 Values for Ceilings $<$ 500'/Visibility $<$1 Mile with 0-Hr Time Differential

Route Distance in Air Kilometers

	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440
Jan.	.92	.87	.82	.77	.73	.68	.64	.61	.57	.54	.51	.48	.45	.42	.40	.38	.35	.33	.31	.30	.28	.26
Feb.	.90	.84	.79	.75	.70	.65	.51	.59	.55	.52	.49	.46	.44	.41	.39	.36	.34	.32	.30	.29	.27	.25
Mar.	.89	.84	.78	.73	.68	.63	.59	.56	.52	.49	.46	.43	.40	.38	.35	.33	.31	.29	.27	.26	.25	.23
Apr.	.87	.80	.73	.67	.62	.57	.52	.48	.44	.40	.37	.34	.31	.29	.26	.24	.22	.20	.19	.17	.16	.15
May	.85	.77	.70	.63	.57	.52	.47	.42	.38	.35	.31	.28	.26	.23	.21	.19	.17	.16	.14	.13	.12	.10
June	.82	.71	.66	.49	.53	.47	.42	.38	.34	.30	.27	.24	.22	.20	.18	.16	.14	.13	.11	.10	.09	.08
July	.81	.70	.64	.57	.50	.44	.39	.35	.31	.28	.24	.22	.19	.17	.15	.13	.12	.11	.09	.08	.07	.07
Aug.	.82	.71	.66	.59	.53	.47	.42	.38	.34	.30	.27	.24	.22	.20	.18	.16	.14	.13	.11	.10	.09	.08
Sept.	.85	.77	.70	.63	.57	.52	.47	.42	.38	.35	.31	.28	.26	.23	.21	.19	.17	.16	.14	.13	.12	.10
Oct.	.87	.80	.73	.67	.62	.57	.52	.48	.44	.40	.37	.34	.31	.29	.26	.24	.22	.20	.19	.17	.16	.15
Nov.	.89	.84	.78	.73	.68	.65	.59	.56	.52	.49	.46	.43	.40	.38	.35	.33	.31	.29	.27	.26	.25	.23
Dec.	.90	.84	.79	.75	.70	.63	.61	.59	.55	.52	.49	.46	.44	.41	.39	.36	.34	.32	.30	.29	.27	.25

r^2 Values for Ceilings $<$500'/Visibility $<$1 Mile with 1-Hr Time Differential

Route Distance in Air Kilometers

	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440
Jan.	.85	.81	.77	.73	.70	.66	.63	.60	.57	.54	.52	.49	.47	.44	.42	.40	.38	.37	.35	.33	.31	.30
Feb.	.83	.79	.75	.70	.67	.64	.61	.58	.55	.52	.49	.47	.44	.42	.40	.38	.36	.34	.32	.31	.29	.28
Mar.	.80	.76	.71	.67	.63	.59	.56	.53	.50	.47	.44	.41	.39	.37	.35	.33	.31	.29	.27	.26	.24	.23
Apr.	.75	.70	.65	.61	.56	.52	.49	.45	.42	.39	.36	.34	.32	.30	.28	.25	.23	.22	.20	.18	.17	.16
May	.73	.66	.59	.53	.48	.44	.39	.35	.32	.29	.26	.23	.21	.19	.17	.15	.14	.12	.11	.10	.09	.08
June	.68	.61	.54	.49	.44	.39	.36	.32	.29	.26	.23	.21	.19	.17	.15	.14	.12	.11	.10	.09	.08	.07
July	.65	.58	.52	.47	.42	.38	.34	.30	.27	.24	.22	.19	.17	.16	.14	.12	.11	.10	.09	.08	.07	.06
Aug.	.68	.61	.54	.49	.44	.39	.36	.32	.29	.26	.23	.21	.19	.17	.15	.14	.12	.11	.10	.09	.08	.07
Sept.	.73	.66	.59	.53	.48	.44	.39	.35	.32	.29	.26	.23	.21	.19	.17	.15	.14	.12	.11	.10	.09	.08
Oct.	.75	.70	.65	.61	.56	.52	.49	.45	.42	.39	.36	.34	.32	.30	.28	.25	.23	.22	.20	.18	.17	.16
Nov.	.80	.76	.71	.67	.63	.59	.56	.53	.50	.47	.44	.41	.39	.37	.35	.33	.31	.29	.27	.26	.24	.23
Dec.	.83	.79	.75	.70	.67	.64	.61	.58	.55	.52	.49	.47	.44	.42	.40	.38	.36	.34	.32	.31	.29	.28

r^2 Values for Ceilings $<$500'/Visibility $<$1 Mile with 2-Hr Time Differential

Route Distance in Air Kilometers

Jan.	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440
Jan.	.79	.76	.73	.70	.68	.65	.63	.59	.58	.55	.53	.51	.49	.47	.45	.44	.42	.40	.39	.37	.36	.34
Feb.	.75	.72	.69	.66	.64	.61	.59	.57	.55	.52	.50	.48	.46	.44	.43	.41	.39	.38	.36	.35	.34	.32
Mar.	.72	.68	.65	.61	.58	.55	.53	.50	.48	.45	.43	.41	.39	.36	.35	.33	.31	.30	.28	.27	.26	.24
Apr.	.64	.60	.57	.54	.51	.48	.45	.42	.40	.38	.35	.33	.31	.30	.28	.26	.25	.23	.22	.21	.19	.18
May	.62	.57	.51	.48	.43	.39	.35	.32	.29	.26	.24	.22	.20	.18	.17	.15	.14	.12	.11	.10	.09	.09
June	.55	.50	.44	.39	.34	.30	.27	.24	.21	.19	.17	.15	.13	.11	.10	.09	.08	.07	.06	.06	.05	.04
July	.52	.46	.40	.35	.31	.27	.24	.22	.18	.16	.14	.13	.11	.10	.09	.08	.07	.06	.05	.04	.04	.03
Aug.	.55	.50	.44	.39	.34	.30	.27	.25	.21	.19	.17	.15	.13	.11	.10	.09	.08	.07	.06	.06	.05	.04
Sept.	.62	.57	.51	.48	.43	.39	.35	.32	.29	.26	.24	.22	.20	.18	.17	.15	.14	.12	.11	.10	.09	.09
Oct.	.64	.60	.57	.54	.51	.48	.45	.41	.40	.38	.35	.33	.31	.30	.28	.26	.25	.23	.22	.21	.19	.18
Nov.	.72	.68	.65	.61	.58	.55	.53	.50	.48	.45	.43	.41	.39	.36	.35	.33	.31	.30	.28	.27	.26	.24
Dec.	.75	.72	.69	.66	.64	.61	.59	.57	.55	.52	.50	.48	.46	.44	.43	.41	.39	.38	.36	.35	.34	.32

Fig. 13

The discussion to follow presents a simplified technique whereby separate estimates of ceiling and visibility probabilities are provided for use in equation 4 to generate the probability of any ceiling/visibility combination desired by the user.

The need for maintaining the accuracy of the data in the compaction process is readily apparent since each equation heretofore presented in this report requires unconditional probabilities as an input. Thus, the benefits to be gained by not assuming independency of weather events could easily vanish if the unconditional probabilities are allowed to be in error in excess of one or two percent in most cases.

Paramount to the choice of one method over another for compacting the data is a knowledge of the diversity of usages to which the data will be subjected. The data compaction scheme illustrated in figures 14-17 can offer valuable ceiling and visibility information for persons in remote operating locations and provides a technique for mass storage of ceiling and visibility climatologies of the world using perhaps a single data tape. Even more noteworthy, it maintains the integrity of the data well within the accuracy set forth by the AWS with a page compaction ratio of some 96 to 1. Note that each of the figures 14 through 17 contains the necessary information for reproducing the RUSSWO data for any ceiling height below 3000' or visibility less than 3 miles for any hour of the day or month of year for the given station under consideration. The data are in a format which allows the climatology for locations (where RUSSWO information is presently at hand or where it is necessary to deduce it by analogy with those stations exhibiting similarities of geography and topography) to be assessed by the inspection of a few numbers. For instance, in figure 14, McGuire AFB exhibits a 7% for ceilings $<500'$, 7% for ceilings <500 to $<1000'$, and 9% for ceilings <1000 to $<3000'$ in January during the 0000 to 0200 hr time period. In May for that same station lower ceilings are found to be more frequent in the early morning hours while the higher ones predominate during the daylight hours. On the other hand, Hill AFB, Utah is seen to be devoid of low ceiling and visibilities during the entire summer season (see Fig. 15).

The format of figures 14 through 17 was chosen to permit rapid interpolations by a simple application of the linear terms of a Taylor series. For example, the probability of ceilings $< 800'$ during the 0300 to 0500 hr period in January at McGuire AFB is

$$P_{500'} + \frac{(P_{1000'} - P_{500'})}{500'} \times 300' = .09 + \frac{3}{5}(.05) = .12$$

Compacted RUSSWO Probabilities for Select Categories of Ceiling and of Visibility for McGuire AFB, New York

Category	Jan								Feb								Mar							
Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0 < 500'	7	9	8	7	5	5	7	7	8	8	8	7	6	6	6	8	8	9	9	6	5	5	6	7
< 500 < 1000'	7	5	7	6	6	6	5	6	4	5	6	7	7	6	7	5	6	6	7	9	8	6	6	5
< 1000 < 3000'	9	9	8	9	10	8	8	8	8	8	8	8	9	8	8	8	6	7	7	10	10	11	8	8
0 < ½ mi	4	4	4	3	2	2	3	3	4	4	4	3	2	2	3	3	3	3	4	2	1	1	1	1
< ½ < 1 mi	2	2	4	4	2	3	2	3	1	3	4	3	2	2	1	2	2	2	3	2	3	2	2	3
< 1 < 3 mi	9	10	11	11	10	9	9	8	10	9	13	11	10	8	10	8	8	10	13	10	7	8	8	7

Category	April								May								June							
0 < 500'	7	10	9	4	2	3	5	7	10	12	10	3	1	1	4	7	8	11	8	1	1	1	2	4
< 500 < 1000'	7	6	7	8	7	6	5	6	5	5	7	9	6	5	4	4	4	5	6	6	3	3	3	4
< 1000 < 3000'	6	7	7	12	12	10	8	6	5	7	8	11	10	8	6	6	6	4	7	12	11	8	6	6
0 < ½ mi	3	4	3	0	0	0	0	1	4	5	4	0	0	0	1	1	3	6	3	0	0	0	0	1
< ½ < 1 mi	1	2	3	1	1	0	1	1	2	3	3	1	0	1	1	2	1	4	2	1	1	0	1	1
< 1 < 3 mi	6	9	12	8	7	8	8	7	5	11	12	8	5	3	5	5	9	15	16	7	4	3	5	6

Category	July								Aug								Sept							
0 < 500'	7	10	9	2	0	1	1	3	8	10	9	3	2	2	3	4	8	10	9	3	2	2	3	4
< 500 < 1000'	4	5	6	6	3	3	3	4	3	6	6	4	1	1	1	4	4	5	7	7	4	5	4	5
< 1000 < 3000'	6	6	8	14	14	9	7	5	6	6	7	15	15	8	5	3	8	9	9	13	14	8	7	7
0 < ½ mi	2	6	4	0	0	0	0	1	3	6	4	0	0	0	0	1	3	6	5	0	0	0	0	1
< ½ < 1 mi	2	4	4	1	0	0	1	0	2	3	3	1	0	0	1	0	2	2	5	1	1	1	1	1
< 1 < 3 mi	10	16	18	8	4	4	5	6	10	16	24	8	4	4	5	6	7	13	20	10	5	5	6	6

Category	Oct								Nov								Dec							
0 < 500'	6	7	8	3	1	1	2	4	6	6	6	4	2	2	4	5	7	7	8	7	6	6	7	7
< 500 < 1000'	3	4	5	6	5	5	4	3	3	6	5	6	6	5	4	3	5	6	4	6	6	6	4	5
< 1000 < 3000'	7	8	8	11	13	8	7	7	10	9	9	9	21	11	9	10	9	8	9	8	9	9	9	9
0 < ½ mi	5	6	6	1	0	0	0	2	3	4	4	1	1	1	0	2	3	3	4	3	2	2	2	3
< ½ < 1 mi	1	2	4	1	0	1	1	1	2	2	3	2	1	2	2	1	2	2	2	3	3	3	3	2
< 1 < 3 mi	7	10	18	11	5	4	5	5	6	6	12	10	6	6	8	7	7	8	14	13	9	9	8	7

Fig. 14

Compacted RUSSWO Probabilities for Select Categories of
Ceiling and of Visibility for Hill AFB, Utah

		Jan								Feb								Mar							
	Category Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-29	21-23
0	< 500'	4	4	4	3	3	2	3	3	3	4	3	2	2	1	2	2	2	2	1	1	1	1	2	1
<500	<1000'	1	3	3	3	2	3	2	2	2	2	2	3	3	3	2	2	1	2	3	3	3	2	1	2
<1000	<3000'	8	8	8	8	10	7	7	9	7	8	9	9	8	8	7	6	6	7	7	7	7	6	5	5
0	<½ mi	3	3	3	3	2	3	3	3	3	3	2	3	2	1	2	2	1	1	1	1	1	1	1	1
<½	<1 mi	2	3	4	4	4	3	2	2	2	3	3	2	3	2	2	1	2	2	2	2	2	1	1	1
<1	<3 mi	7	6	5	8	8	8	8	7	3	3	6	6	6	6	5	4	2	3	4	4	3	2	2	2
		April								May								June							
0	< 500'	2	2	1	1	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<500	<1000'	1	1	2	1	2	2	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0
<1000	<3000'	5	6	5	7	6	4	4	4	2	2	2	3	2	2	1	1	1	1	2	1	1	1	1	1
0	<½ mi	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<½	<1 mi	1	1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
<1	<3 mi	2	2	2	2	2	2	2	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0
		July								Aug								Sept							
0	< 500'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<500	<1000'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<1000	<3000'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	<½ mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<½	<1 mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<1	<3 mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Oct								Nov								Dec							
0	< 500'	1	1	1	1	0	1	0	0	2	2	2	1	1	2	1	2	7	6	5	4	3	4	6	7
<500	<1000'	0	0	0	0	1	0	1	1	1	1	1	2	2	1	2	1	3	4	4	5	5	4	3	4
<1000	<3000'	2	3	3	3	4	3	2	2	5	5	5	5	6	5	5	5	6	6	7	8	9	9	8	6
0	<½ mi	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	6	5	4	3	3	3	4	6
<½	<1 mi	0	0	1	1	1	0	0	0	1	1	1	1	2	1	1	1	2	2	3	4	4	4	3	2
<1	<3 mi	1	1	0	0	0	1	1	1	2	2	2	3	3	3	3	2	6	7	7	10	12	12	9	7

Fig. 15

Compacted RUSSWO Probabilities for Select Categories of
Ceiling and of Visibility for Andrews AFB, Maryland

Jan

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	8	9	9	8	5	6	6	7
< 500	< 1000'	5	5	5	5	6	4	3	4
< 1000	< 3000	7	7	7	6	9	8	8	7
0	< ½ mi	4	4	4	3	2	2	2	3
< ½	< 1 mi	2	3	3	3	3	3	3	2
< 1	< 3 mi	7	8	10	11	8	7	6	6

Feb

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	10	10	10	8	6	6	7	9
< 500	< 1000'	3	3	4	6	6	5	5	4
< 1000	< 3000	5	5	5	6	7	7	5	4
0	< ½ mi	3	4	5	2	2	1	2	3
< ½	< 1 mi	2	2	3	4	3	3	1	2
< 1	< 3 mi	8	7	10	11	9	8	9	7

Mar

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	8	9	9	6	5	5	6	7
< 500	< 1000'	4	4	5	7	5	5	4	4
< 1000	< 3000	5	6	6	8	9	7	5	5
0	< ½ mi	3	3	4	1	1	1	1	2
< ½	< 1 mi	1	2	2	3	1	1	1	2
< 1	< 3 mi	7	7	9	8	7	7	7	6

April

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	7	9	9	5	3	3	4	6
< 500	< 1000'	4	3	4	6	6	5	4	3
< 1000	< 3000'	6	7	5	6	7	6	5	4
0	< ½ mi	2	3	3	1	0	0	1	2
< ½	< 1 mi	1	2	2	1	1	1	1	0
< 1	< 3 mi	6	5	8	6	6	6	5	5

May

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	7	9	8	3	2	1	2	4
< 500	< 1000'	4	6	8	6	4	4	4	4
< 1000	< 3000'	7	6	5	11	10	8	5	5
0	< ½ mi	2	4	3	0	0	0	1	1
< ½	< 1 mi	1	2	2	1	0	1	0	0
< 1	< 3 mi	6	8	10	5	4	4	4	6

June

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	4	6	5	2	1	1	1	2
< 500	< 1000'	2	3	5	5	3	2	2	3
< 1000	< 3000'	6	6	6	9	9	6	6	5
0	< ½ mi	1	2	1	0	0	0	0	0
< ½	< 1 mi	0	1	2	0	0	0	0	0
< 1	< 3 mi	4	9	10	6	4	4	4	4

July

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	2	4	3	1	0	0	0	1
< 500	< 1000'	3	4	7	3	2	2	2	2
< 1000	< 3000'	3	4	5	13	10	7	5	4
0	< ½ mi	1	2	2	0	0	0	0	0
< ½	< 1 mi	0	2	1	0	0	0	0	0
< 1	< 3 mi	4	8	10	4	2	3	4	3

Aug

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	2	5	5	1	1	1	1	2
< 500	< 1000'	3	4	7	6	2	1	2	1
< 1000	< 3000'	5	5	5	12	11	7	4	5
0	< ½ mi	1	2	2	0	0	0	0	0
< ½	< 1 mi	0	2	2	1	0	0	0	0
< 1	< 3 mi	5	9	15	5	3	3	3	4

Sept

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	5	7	7	3	2	2	2	3
< 500	< 1000'	4	5	7	7	3	3	3	3
< 1000	< 3000'	4	6	7	10	12	6	5	5
0	< ½ mi	1	3	4	0	0	0	0	0
< ½	< 1 mi	1	2	2	1	0	1	1	1
< 1	< 3 mi	6	7	13	7	5	4	4	4

Oct

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	6	8	9	4	2	2	3	4
< 500	< 1000'	2	3	5	6	5	4	3	3
< 1000	< 3000'	7	7	7	10	9	7	5	5
0	< ½ mi	3	5	6	1	0	0	0	1
< ½	< 1 mi	1	2	3	1	1	1	1	1
< 1	< 3 mi	5	6	11	9	4	5	4	4

Nov

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	6	7	7	6	3	3	4	5
< 500	< 1000'	3	3	4	5	4	3	3	2
< 1000	< 3000'	6	6	5	6	8	7	6	7
0	< ½ mi	2	4	4	1	0	1	1	2
< ½	< 1 mi	1	1	2	2	1	1	1	0
< 1	< 3 mi	6	5	8	8	7	5	4	5

Dec

	Category	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0	< 500'	7	8	9	8	6	6	7	7
< 500	< 1000'	3	4	4	5	6	5	4	4
< 1000	< 3000'	6	4	4	6	7	6	6	5
0	< ½ mi	3	3	4	3	2	2	2	3
< ½	< 1 mi	2	2	2	3	3	2	1	1
< 1	< 3 mi	6	7	10	10	7	8	8	6

Fig. 16

Compacted RUSSWO Probabilities for Select Categories of Ceiling and of Visibility for Travis AFB, California

Category	Jan								Feb								Mar							
Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
0 < 500'	14	18	19	17	9	5	8	11	6	8	9	7	3	1	2	4	0	1	1	1	0	0	0	0
< 500 < 1000'	4	3	4	6	9	9	6	5	2	3	4	5	4	3	2	2	1	1	2	2	1	1	1	1
< 1000 < 3000'	9	11	11	10	13	11	10	8	8	8	9	11	13	11	8	6	7	8	8	10	10	7	6	6
0 < ½ mi	12	14	17	11	3	1	4	8	4	7	8	4	0	0	1	3	0	0	1	0	0	0	0	0
< ½ < 1 mi	4	5	5	5	2	2	2	2	1	2	4	1	1	0	1	0	0	1	1	0	0	0	0	0
< 1 < 3 mi	10	12	13	15	14	12	11	10	6	7	9	9	5	4	4	5	1	1	2	2	1	1	1	1

Category	April								May								June							
0 < 500'	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< 500 < 1000'	1	1	0	1	0	0	0	0	2	3	2	0	0	0	0	1	2	3	2	0	0	0	0	0
< 1000 < 3000'	5	5	6	7	5	4	4	4	5	6	7	8	5	3	2	2	2	3	5	4	2	1	1	1
0 < ½ mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< ½ < 1 mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< 1 < 3 mi	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Category	July								Aug								Sept							
0 < 500'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< 500 < 1000'	1	2	1	0	0	0	0	0	1	2	1	0	0	0	0	0	0	1	1	0	0	0	0	0
< 1000 < 3000'	1	1	2	1	0	0	0	0	1	2	3	2	0	0	0	1	1	2	2	1	1	0	0	1
0 < ½ mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< ½ < 1 mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
< 1 < 3 mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Category	Oct								Nov								Dec							
0 < 500'	1	1	1	1	0	0	0	0	5	7	8	7	3	2	2	4	14	18	21	18	10	7	10	13
< 500 < 1000'	1	1	2	1	1	1	1	1	2	2	3	3	3	3	3	2	7	7	6	7	12	10	8	6
< 1000 < 3000'	3	4	4	5	4	3	2	2	4	6	7	8	9	6	5	4	10	11	12	13	12	12	10	9
0 < ½ mi	0	1	1	0	0	0	0	0	4	7	9	4	0	0	1	2	9	12	15	8	2	1	4	7
< ½ < 1 mi	0	0	1	0	0	0	0	0	1	2	3	1	1	1	0	1	3	5	5	6	3	2	2	3
< 1 < 3 mi	2	2	3	2	1	1	1	1	6	7	9	10	7	5	5	6	14	13	16	16	15	14	14	14

Fig. 17

It is thus a simple procedure to condense some 300 or so volumes of RUSSWO data available at ETAC into one volume of some 300 pages using the aforementioned procedure. Obviously the ceiling and visibility limits could be extended to incorporate a greater portion of the RUSSWO's data if desired with little, if any, additional cost in terms of total number of pages required.

Other more sophisticated approaches have their appeal and are worthy of investigations. However, if expediency is in order, the method discussed above will provide the information necessary for input into the many equations of this report. The accuracy of the entire process is illustrated by figure 18 for two arbitrarily selected stations and categories.

Probabilities of Ceilings < 1000' and/or Visibilities < 1 Mile Extracted from the RUSSWO for McGuire AFB, New York

Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
Jan	14	15	16	14	12	12	12	14
Feb	13	14	16	15	13	12	13	14
Mar	15	16	17	15	13	11	13	13
April	15	17	17	12	9	9	11	13
May	15	19	18	12	7	6	8	11
June	13	20	15	7	4	4	5	8
July	13	19	17	8	3	4	4	7
Aug	13	18	17	7	4	3	4	8
Sept	13	18	19	10	7	7	7	10
Oct	11	15	18	10	6	6	7	8
Nov	11	13	14	11	8	8	9	9
Dec	13	15	14	14	13	12	12	13

Probabilities of Cig < 1000' and/or Vsby < 1 Mi for McGuire AFB Computed by the Formula $1\text{-}CMSI_t = \sqrt{\frac{P_a+P_b}{2} + \left(\frac{P_a+P_b}{2}\right)^2 - .87\,P_aP_b}$ and the Rounded-Off Ceiling and Visibility Probabilities of Fig. 14.

Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
Jan	14	14	17	15	12	12	13	14
Feb	13	15	16	14	13	13	13	14
Mar	15	15	17	16	13	11	13	13
April	15	17	17	12	9	9	10	13
May	16	19	18	12	7	6	8	11
June	13	18	15	7	4	4	5	8
July	12	19	17	8	3	4	4	7
Aug	12	18	17	7	3	3	4	8
Sept	13	17	18	10	6	7	7	9
Oct	11	13	16	9	6	6	6	8
Nov	10	13	13	11	8	8	8	9
Dec	13	14	13	14	13	13	12	13

Same as above except for Andrews AFB, Maryland

Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
Jan	14	16	15	14	12	11	10	12
Feb	13	13	15	15	13	12	12	13
Mar	13	13	15	13	11	10	10	11
April	11	13	13	11	9	8	8	9
May	12	16	16	9	6	5	6	8
June	6	10	11	7	4	3	3	5
July	5	9	11	4	2	2	2	3
Aug	5	11	13	7	3	2	3	3
Sept	9	14	15	10	5	5	5	6
Oct	10	13	16	11	7	6	6	7
Nov	10	11	12	11	8	7	7	8
Dec	11	12	14	13	13	11	11	11

Same as above except for Andrews AFB and the unconditional probabilities, P_a and P_b from fig. 16.

Hr	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
Jan	14	15	15	14	12	11	11	12
Feb	14	14	16	14	13	12	13	14
Mar	13	14	15	13	10	10	10	12
April	11	13	14	11	9	8	8	9
May	11	16	17	9	6	5	6	8
June	6	10	11	7	4	3	3	5
July	5	9	11	4	2	2	2	3
Aug	5	10	13	7	3	2	3	3
Sept	9	13	14	10	5	5	5	6
Oct	9	13	16	10	7	6	6	7
Nov	10	11	12	11	7	7	7	7
Dec	11	13	14	14	13	12	11	12

Fig. 18

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